Acta Pædiatr Scand 77: 716–720, 1988

Sensitization of Children in the Stockholm Area to House Dust Mites

S. L. NORDVALL, M. ERIKSSON, E. RYLANDER and B. SCHWARTZ

From the Department of Paediatrics, St. Göran's Children's Hospital, Stockholm, Sweden and Allergologisk Laboratorium, Copenhagen, Denmark

ABSTRACT. Nordvall, S. L., Eriksson, M., Rylander, E. and Schwartz, B. (Department of Paediatrics, St. Görans Children's Hospital, Stockholm, Sweden and Allergologisk Laboratorium, Copenhagen, Denmark). Sensitization of children in the Stockholm area to house dust mites. Acta Paediatr Scand 77: 716, 1988.

Atopic sensitization of children in the Stockholm area to house dust mites (HDM) was investigated in a case-control study. Sixty children with and 60 without positive skin prick tests for HDM were matched for age and sex. HDM-sensitized children had previously more often lived in other areas known to be mite infested than the control children. Sensitization to mites was related to dampness in the homes, but no significant relationship was found to the type of residence, frequent visits to a summer house in the archipelago or parental smoking. Dust samples from mattresses of the children with the strongest positive reactions to mites in skin prick tests and the respective controls were subjected to an enzyme immunoassay, to measure the content of the major allergens of the Dermatophagoides (*D.*) species *D. pterinyssinus*, *D. farinae* and *D. microceras*. Mattress dust samples from the beds of HDM-sensitized children contained significantly higher HDM antigen concentrations than those from the beds of controls. Private houses contained significantly more HDM antigens than flats and 10 of 11 homes in which a dampness problem was recognized contained mite antigens. It is postulated that mite infestation is increasing in the area, energy-saving measures creating improved conditions for HDM survival. *Key words: house dust mites, Dermatophagoides, allergen analysis, ELISA.*

House dust mites of the genus *Dermatophagoides* (HDM) are known to be important allergens in cases of dust allergy (1, 2). The growth and survival of HDM are known to depend on climatic conditions, the most important being the humidity in the homes (2–8). For HDM survival a relative humidity (RH) of 55% is required and the optimal RH for HDM growth is known to be as high as 75–80%. Since climatic conditions thus greatly influence the quantities of HDM in house dust, considerable differences are found between different geographic regions (9, 10), between seasons (11, 12) and also between different houses (7).

The general climatic conditions in the Stockholm area are unfavourable for growth of HDM, the winters being cold, with a prolonged indoor heating season and an indoor RH that is generally much below the critical 55% for HDM survival. In a previous study (13) mite concentrations in house dust from this area were found to be very low and *Dermatophagoides* were virtually absent. Yet in our daily practice we see children who are obviously sensitized to HDM, as shown by positive skin prick tests and radioallergosorbent tests for these allergens. This study was undertaken to find out the causes of sensitization to HDM in our area.

MATERIAL AND METHODS

The study comprised children who were attending the out-patient allergy clinic of St. Göran's Children's Hospital in 1984–1986 for routine tests. Skin prick tests (SPT) were carried out in accordance with the Nordic guidelines (14); during the period January 1984 to November 1985 Pharmalgen® 10000 BU (Pharmacia AB, Uppsala, Sweden) was used and from December 1985 onwards the tests were performed with allergen precoated lancets (Phazet®) from the same supplier. The wheal sizes were related to those of histamine hydrochloride 1 mg/ml. A panel of ten allergens was used: *Dermatophagoides pterinyssinus* (D.pt.), *Dermatophagoides farinae* (D.f.), cat, dog, horse, timothy, *Cladosporium her-*

2023510300

Source: https://www.industrydocuments.ucsf.edu/docs/tfpx0000

barum, *Alternaria alternata*, birch and mugwort. Sixty-six children with a positive SPT reaction (1+ or more, minimal mean wheal size 2.5 mm with a flare) to either or both of the two *Dermatophagoides* species were included in the study. Another 66 children who had been tested during the same time period for suspected allergies but had negative SPT to both *Dermatophagoides* species in SPT served as controls. A total of 80 boys and 52 girls aged 3–17 years were included in the study. Matching was performed with respect to both age and sex.

Questionnaire. The parents were asked to complete a questionnaire concerning the children's previous environment, i.e. whether they had lived in mite-infested regions in southern Sweden or abroad. Questions were also asked about paternal and maternal smoking, type of residence—i.e. whether they lived in a private house or a flat—and whether the family frequented a summer house in the Stockholm archipelago. There was also a question as to whether dampness was recognized as a problem in their permanent home. Forms were completed for 60 matched pairs of children.

Dust sampling. A mattress dust sample was requested from the beds of those mite-sensitized children who had displayed at least one 3+ SPT reaction to either of the two HDM species or 2+ reactions to both, and also from the beds of the respective controls. Dust from houses where a moisture problem had been acknowledged was also collected. Sampling was performed as described by Mosbech & Lind (15), by the parents, using their usual vacuum cleaner and a specially designed nozzle with a thick filter paper (13). This was done in 1986 from the last week of September to the end of October. Out of 62 requested samples, 54 were obtained and analysed.

Dust analyses. Aqueous extracts were prepared as previously described by suspending each gram of the dust sample in 5 cc of 0.9% saline (16). The contents of HDM antigens were determined by an enzyme-linked immunosorbent assay (ELISA), using affinity purified monospecific antisera against the major mite allergens of three *Dermatophagoides species: pteronyssinus* (antigen Der pI, formerly Dp 42 or P1), *farinae* (antigen Der fI) and *microceras* (antigen Der mI) (17). Standard Quality HDM extracts from Allergologisk Laboratorium A/S, Copenhagen, Denmark, were used as reference allergen solutions. Standard curves were run simultaneously on each of the plates. Less than 0.1% cross-reactivity was observed between these species-specific antisera in the ELISA assay (17).

Statistics. Fisher's exact test was used for comparison of data for cases and controls obtained by the questionnaires. Non-parametric tests were used in the processing of data for dust antigen contents, paired tests for the matched case–control comparisons (Wilcoxon signed ranks test) and the Mann-Whitney test for other comparisons.

RESULTS

Questionnaire. A significantly higher proportion of the children with positive SPT to HDM than of the controls, reported long stays in mite-infested areas abroad or in southern Sweden (Table 1). More mite-sensitized children than control children lived in private houses but this difference was not significant. The parents of mite-sensitized children acknowledged a problem of dampness in their home more frequently than those of the controls ($p<0.006$). The frequency of visits to a summer house in the archipelago was similar in the two groups. A higher proportion of the mothers of mite-sensitized children than of control children were smokers, but this difference was not significant ($p<0.16$).

Table 1. *Data on environmental factors obtained from questionnaire*

	Travel		Private house		Dampness in home		Summer-house		Mother smoker		Father smoker	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Case	32	21	28	29	11	46	12	45	22	35	12	44
Control	17	39	22	38	2	58	17	43	17	43	18	41
p values	<0.003		<0.12		<0.006		<0.24		<0.16		<0.18	

Cases (mite-sensitized children) compared with controls (children without sensitization to mites). Statistics: Fisher's exact test. Travel=children with and without frequent stays in southern Sweden or other mite infested areas.

2023510301

Source: https://www.industrydocuments.ucsf.edu/docs/tfpx0000

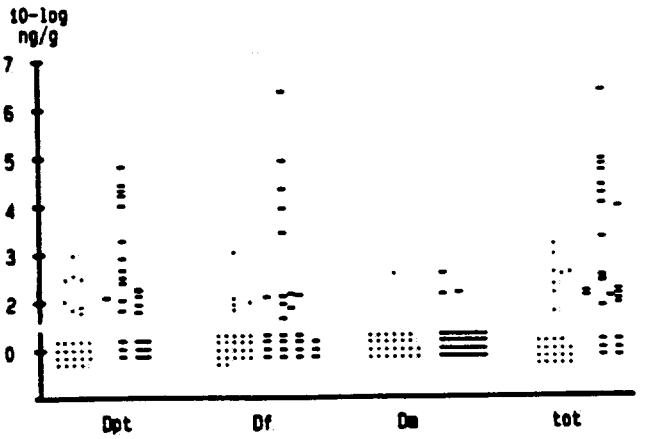

Fig. 1. House dust mite antigen contents from beds of mite-sensitized children (–) and controls (•). Dpt, Df and Dm = contents of antigens DerpI, DerfI and DermI, respectively. tot = total amount of the three *Dermatophagoides* antigens.

Dust analyses. HDM antigens Der pI and Der fI were found in a considerable proportion of the dust samples, whereas antigen Der mI was found only sparsely. Dust from the homes of mite-sensitized children contained larger total amounts of mite antigens than dust from the homes of controls (Fig. 1) ($p<0.001$). This difference was significant both for Der pI ($p<0.02$) and for Der fI ($p<0.03$). The difference in mite antigen contents between private houses and flats (Fig. 2) was striking and was significant both for the total mite antigen contents ($p<0.001$) and for Der pI ($p<0.005$) and Der fI ($p<0.02$). A high proportion (10 of 11) of the dust samples obtained from houses where a dampness problem was recognized contained HDM antigens (Fig. 3).

DISCUSSION

From the results of this study two explanations emerge for the mite-sensitization observed among children in a Stockholm allergy clinic. One of them is obvious, i.e. previous residence in or frequent visits to other more heavily mite infested areas. The most important cause of the sensitization of the children, however, was the occurrence of HDM antigens in

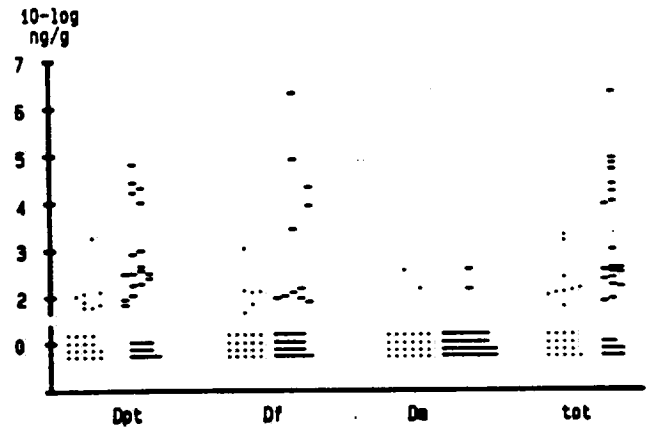

Fig. 2. House dust mite antigen contents from private houses (–) and flats (•). For further explanations, see legend to Fig. 1.

2023510302

Source: https://www.industrydocuments.ucsf.edu/docs/tfpx0000

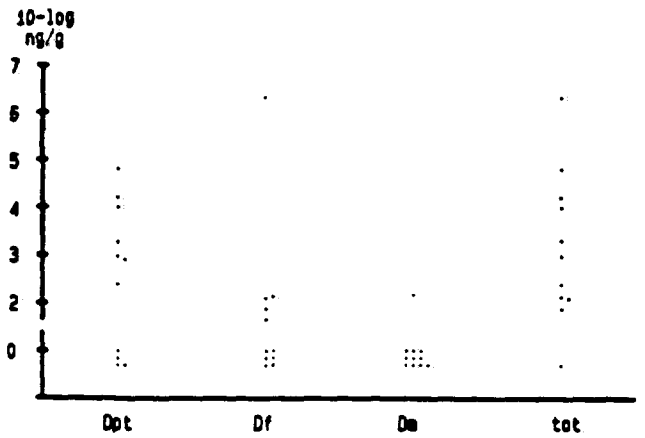

Fig. 3. House dust mite antigen contents in homes with acknowledged dampness problems. For further explanations, see legend to Fig. 1.

the dust of their homes. It is apparent from our data that the concentrations of HDM antigens may reach extreme peak levels in our homes.

In a previous study (13) *Dermatophagoides* were found to be very rare in the homes of the area. There may be several explanations for the divergent results of these two studies. In the previous study dust was collected from the homes of adults. A correlation between mite-sensitization in adults and the presence of HDM in their current homes is not expected to the same degree as in children, since adults are more likely to have been sensitized elsewhere and at a younger age. Further, in Turos' study (13) dust was collected all through the year, whereas our samples were collected in the autumn, when peak levels could be anticipated. Microscopy was used in Turos' study for the detection and quantification of mites, whereas we used a modern ELISA technique. These two techniques are not known to differ, however, when properly performed (17). Even though some differences in the design of the two studies may thus partly explain the discrepant results, it appears probable, that the difference reflects a true increase in HDM infestation in the area.

Increased mite infestation is a possible consequence of the changes in the construction of buildings that resulted from the energy crisis in the early seventies. Improved insulation and decreased ventilation of homes may have created a more favourable indoor climate for mite survival. Many homes in Sweden that were constructed in the late seventies smell of mould, but this problem occurs only rarely in older buildings and then often in conjunction with renovations (18). These findings are in accordance with the hypothesis that mite infestation of homes has increased and that the consequent sensitization to mites and clinical mite allergy may be of increasing importance in our area. Our findings, that private houses are more prone to mite infestation than flats, and the observed and very likely relation to problems of dampness, add further support to this notion.

In a majority of the dust samples HDM antigens were not detectable by the ELISA technique. This contrasts with findings from Copenhagen, where only a minority of the houses were found to be free of HDM antigens, when the same ELISA technique was used to examine dust from unselected houses (17). The general climatic conditions are probably more favourable for mite growth in Denmark than in our area, where the indoor climate possibly has a greater impact. In Denmark too, however, there are considerable discrepancies in the concentrations of HDM in house dust between different houses (7, 17), which has been attributed in part to differences in housing conditions (7).

The spread of HDM to houses of our temperate regions, where the general climatic con-

2023510303

Source: https://www.industrydocuments.ucsf.edu/docs/tfpx0000

ditions are unfavourable for mite growth, deserves further attention. Technical investigations of the types of houses that are associated with these problems seem important from a preventive aspect. Those who have already encountered this problem in their homes need technical advice to help them to eliminate mites. Studies performed in other regions of the world do not necessarily apply to our local conditions, and effects of improved ventilation and other measures for HDM sanitation should also be evaluated here.

ACKNOWLEDGEMENTS

This study was supported by the Research Funds of the Karolinska Institute. Sig-Britt Spång is gratefully acknowledged for administering the study.

REFERENCES

1. Berrens L. The allergens of house dust. Prog Allergy 1970; 14: 259–339.
2. Voorhorst R, Spieksma FTM, Varekamp H, Leupen MJ, Lyklema AW. The house-dust mite (*Dermatophagoides pteronyssinus*) and the allergens it produces. Identity with the house dust allergen. J Allergy 1967; 39: 325–39.
3. Burr ML, Dean BV, Merret TG, Neale E, St Leger AS, Verrier-Jones ER. Effects of anti-mite measures on children with mite sensitive asthma: a controlled trial. Thorax 1980; 35: 506–12.
4. Dobson RM. Some effects of microclimate on the longevity and development of *Dermatophagoides pteronyssinus* (Trouessart). Acarologia 1979; 21: 482–86.
5. Koekkoek HHM, van Bronswijk JEMH. Temperature requirements of a house-dust mite *Dermatophagoides pterinyssinus* compared with the climate in different habitats of houses. Entomol Exp Appl 1972; 15: 438–42.
6. Korsgaard J. Preventive measures in mite asthma A controlled trial. Allergy 1983; 38: 93–102.
7. Korsgaard J. Mite asthma and residency. A case–control study on the impact of exposure to house-dust mites in dwellings. Am Rev Respir Dis 1983; 128: 231–35.
8. Mosbech H. House dust mite allergy. Allergy 1985; 40: 81–91.
9. Green WF, Sedgwick C, Woolcock AJ, Leeder SR, Stuckey M. House dust mites and skin tests in different Australian localities. Aust NZ J Med 1986; 16: 639–43.
10. Murray AB, Fergusson AC, Morrison BJ. Sensitization to house dust mites in different climatic areas. J Allergy Clin Immunol 1985; 76: 108–12.
11. Arlian LG, Bernstein IL, Gallagher JS. The prevalence of house dust mites, *Dermatophagoides* spp., and associated environmental conditions in homes in Ohio. J Allergy Clin Immunol 1982; 69: 527–32.
12. Hallas TE, Korsgaard J. Annual fluctuations of mites and fungi in Danish house-dust: An example. Allergol Immunopathol 1983; 11: 195–200.
13. Turos M. Mites in house dust in the Stockholm area. Allergy 1979; 34: 11–18.
14. Aas K, Belin L. Standardization of diagnostic work in allergy. Acta Allergol 1974; 29: 239–40.
15. Mosbech H, Lind P. Collection of house dust for analysis of mite allergens. Allergy 1986; 41: 373–78.
16. Schwartz B, Gravesen S, Petersen BN, Weeke ER. Laboratory investigations for allergens in the home. Ugeskr Laeger 1979; 141: 882–86.
17. Lind P. Enzyme-linked immunosorbent assay for determination of major excrement allergens of house dust mite species *D. pterinyssinus*, *D. farinae* and *D. microceras*. Allergy 1986; 41: 442–51.
18. Samuelsson I. Sick houses—a problem of moisture. In: Berglund B, Lindvall T, Sundell J, eds. Indoor air. Stockholm: Swedish Council for Building Research, 1984; Vol 1: 341–46.

Submitted June 6, 1987. Accepted March 11, 1988

(S. L. N.) Department of Paediatrics
S:t Göran's Hospital
S-11281 Stockholm
Sweden

2023510304

Source: https://www.industrydocuments.ucsf.edu/docs/tfpx0000